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Abstract

Study of Released Activity Distributions with Thermoluminescence

Dosimeters

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As a complement to other experimental methods for the study of the behaviour of radioactivity released in free air or water, there is a need for a technique consisting of mapping the exposure distribution from a controlled discharge of for instance A^{41} in air or Br^{82} in water. From the radiation protection point of view, such work must be performed with the smallest possible amount of radioactivity. This implies that a type of dosimeter is required with which some tens of microroentgens can be measured, i. e. an exposure of the same order of magnitude as that caused by the natural background radiation during a few hours. The dosimeter should also be cheap and simple so that many measuring points can be used in an experiment.

These requirements eliminate most types of dosimeters, but are fulfilled by a dosimeter which we have developed on the basis of the thermoluminescent properties of $CaSO_4:Mn$. The thermoluminescence of this phosphor shows a high sensitivity to ionizing radiation. Its limited thermal stability does not cause any serious difficulties in controlled experiments. The dosimeters are constructed for measurements of exposures of gamma radiation only, and under laboratory conditions the reproducibility at 50 microroentgens is better than $\pm 20\%$ (standard deviation). In field experiments, the exposure to natural background radiation impairs the precision somewhat.

The feasibility of mapping exposure distributions with these dosimeters has been studied in some experiments. A^{41} was released in free air near the

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ground, and the exposures were measured in a vertical plane about 100 meters from the release point. Practical experience was satisfactory. This is also true for experiments in water with Br^{82} . These experiments will be described.

In many release problems, the concentration is the required quantity rather than the exposure. In air, the interpretation of the results in terms of concentration is complicated by the fact that activity at large distances from the measuring point contributes significantly to the exposure. This problem has been studied with numerical calculations. The spatial resolution is sufficient for most practical problems. This is also the case in water, where the photons have a short practical range.

The technique described is best suited for experiments on a relatively small scale, where the distance between release point and measuring point is less than say 200 meters. It has the advantage of providing a large number of measuring points in fixed positions. In many cases it can be used where other methods, including calculations, are questionable or impossible, as for instance in or near buildings and in vegetation. In this way, the technique can be a valuable complement to established methods for the study of the behaviour of radioactivity released in air or water.



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Factors of Safety, Hygiene and Economy in Locating Different Types
of Large Thermal Power Stations in Sweden

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Savings in capital costs with larger sizes are greater for nuclear units than for conventional ones. Also the existing trend towards very large thermal stations makes the choice between the two energy sources largely dependent upon the factors of hygiene and safety.

Thus, when or even before nuclear power is competitive it is a prime requisite for a country to analyse and to determine on equal terms the public health and safety criteria for alternative generating sources. The use of fossile fuels has been accompanied by a regrettable toll in lives beside damage and nuisance to the surroundings. In the nuclear industry on the other hand the siting and safety criteria used are sometimes overambitious and arbitrary.

In Sweden thermal power stations will for load reasons within the next 10 - 15 years be located in the south. Underground nuclear stations located in the inland is however desirable from a strategic view point. The scarcity of inland recipients large enough for stations of 1 000 Mw elect. capacity and the additional capital cost of building an underground station makes the possibility of inland location rather remote. Large conventional stations must be situated at the coast, due to transport facilities as all fossile fuel in Sweden is imported.

Preliminary surveys show that there are in all about 10 - 15 sites along the coastland of southern Sweden that could provide the necessary harbour, transportation and cooling water for large thermal power stations. A coal fired

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station of 2 000 Mw elect. requires about 150 000 m² storing area for the coal and almost the same area for the ash. For an oil fired station the harbour must accommodate ships of 50 000 - 60 000 t delivering about 2.5 Mt oil per year or one shipload per week. About a third of the yearly consumption must be stored according to authority regulations. The dust, noise, water contamination and fire hazards of all this handling must not be overlooked. The problem of transport and storing at a nuclear station seems on the other hand to be comparatively small.

The nuclear siting practice applied hitherto in Sweden has in principle emphasized the importance of the distance factor. For future large nuclear stations, with units in excess of 500 Mw elect., difficulties in siting may arise even at low populated Swedish coastland. It is of prime importance that this obstacle will be overcome by using inherently safe reactors and consequence limiting safeguards.

Oil and coal-fired stations lack practical means of reducing air pollution through combustion nuclei and oxides of sulphur and nitrogen. In comparison the radiation dose to the public from a nuclear station is negligible and always predictable and in the hands of the operator even in the case of a major incident.

In spite of the unavoidable discharge from a nuclear station to the water recipient, the main factor influencing the recipient will be the temperature increase of the cooling water, which is common to all types of stations.